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Capital Flows and Long-Term Equilibrium Real Exchange Rates in Chile

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Cointegration techniques are used to disentangle the effect of capital flows on the equilibrium real exchange rate. Short-term flows and portfolio investment were found to have no influence, but sustainable long-term inflows and foreign direct investment have an appreciating effect. So, an important part of the actual appreciation of the Chilean peso would not require counterbalancing exchange rate or macroeconomic policies.

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Summary findings

In the context of an empirical model, Elbadawi and Soto examine the impact of capital flows, among other fundamentals, on long-term exchange rates in Chile.

The real exchange rate and its fundamentals were found to be cointegrated during 1960–92. This cointegration allows a reinterpretation of uni-equational estimates of the equilibrium real exchange rate (ERER) to be consistent with long-run forward-looking behavioral models. It also permits the estimation of an error-correction model capable of disentangling short-run from long-run shocks in observed movements of the ERER. And the nonstationary nature of the fundamentals allows one to decompose innovations into permanent and transitory components — to get an empirical measure of the sustainability of the fundamentals with which the ERER is determined.

In general, the estimate of the cointegration of the ERER and its corresponding dynamic error-correction specification corroborates the theoretical model and produces fairly consistent results.

The derived ERER index and the corresponding real exchange rate misalignment (for given sustainable values of the fundamentals) successfully reproduce the salient episodes in Chile's recent macroeconomic history.

Capital flows are disaggregated into four components:

- Short-term capital flows.
- Long-term capital flows.
- Portfolio investment.
- Foreign direct investment.

As expected from economic theory, short-term capital flows and portfolio investment were found to have no effect on the ERER (although they can affect the real exchange rate in the short run).

But long-term capital inflows and foreign direct investment have a significant appreciating effect on the ERER.

To the extent that the recent inflow of capital to Chile is dominated by long-term capital flows that are judged to be sustainable, an important part of the ensuing appreciation of the real exchange rate is consistent with equilibrium behavior — reducing the need for counterbalancing exchange rate or macroeconomic policies.

This paper — a product of the Macroeconomics and Growth Division, Policy Research Department — is part of a larger effort in the department to understand the links of foreign shocks and macroeconomic policies. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Rebecca Martin, room N11-043, extension 39065 (34 pages). June 1994.

CAPITAL FLOWS AND LONG-TERM EQUILIBRIUM REAL EXCHANGE RATES IN CHILE

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1. INTRODUCTION

During the last years Latin American countries, and notably Chile, have experienced an important recovery in their ability to attract foreign capital, particularly from private lenders. From an historical low level of US$ 9.5 billion per year in the 1985-88 period, capital inflows to the region increased to US$ 25.3 billion per year in the 1989-92 period (Calvo et al, 1993). This bonanza, however, has raised also some concerns on the part of the authorities which find it increasingly difficult to pursue monetary and exchange rate policies. In the case of Chile, the role of capital flows in disrupting macroeconomic management, the extent to which these inflows are sustainable, and whether or not their influence on the real exchange rate is consistent with equilibrium behavior, have been subjects of controversy in recent macroeconomic debates (see Arrau et al, 1992).

From a policy point of view this debate is of importance. When dealing with massive capital flows the authority faces a trade-off between allowing the exchange rate to appreciate, thus having a negative impact on the competitiveness of exports, and sterilizing these effects, thus inducing losses to the Central Bank. In the Chilean case this dilemma has a bitter precedent: the appreciation of the exchange rate in the 1979-82 period has been repeatedly linked to the inflow of more than US$ 11 billions and the subsequent debt crisis; the current inflow (US$ 9 billions in the 1989-92 period) has raised justifiable concerns on the current policy. However, the direction of causality between the RER and capital inflows has remained a controversial issue in the Chilean economic literature. Edwards (1988) and Morande (1988) found evidence that massive capital inflows during the late 1970s induced the appreciation of the RER and the loss of competitiveness of Chilean exports. On the other hand, Corbo (1985), among others, presents evidence of the reverse causality; i.e, that the mismanagement of the nominal exchange rate (fixed for almost three years, despite large differentials between domestic and foreign inflation) caused an increased overvaluation of the peso, inducing a substantial premium for deposits in local currency and attracting foreign capital.

This paper contributes to this debate by estimating the long-run equilibrium path between the RER and capital flows, among other fundamentals. The cointegrated equilibrium is obtained from the basic model of the real exchange rate that characterizes the equilibrium as "the relative price of non-tradables to tradables goods which, for given sustainable values of other relevant variables such as taxes, international terms of trade, commercial policy, capital and aid flows and technology, results in the simultaneous attainment of internal and external equilibrium", (Edwards (1989), pp. 16). We extend the standard models of Rodriguez (1989) and Elbadawi (1993) by allowing capital flows to be disaggregated into four components: short-term capital flows, long-term capital flows, portfolio investment and direct foreign investment.

Unlike under other definitions (eg, the PPP theory), the equilibrium real exchange rate (ERER) in this case experiences movements in response to exogenous and policy-induced shifts in its real fundamentals. Furthermore, this notion of equilibrium is essentially intertemporal as the path of the ERER is affected not only by the current values of the fundamentals, but also by anticipations regarding the future evolution of these variables.[1] Regarding capital flows, consistency with arbitrage theories suggests that short-term flows and portfolio investment should have no influence in the ERER; on the contrary, long-term flows and foreign direct investment are expected to have permanent effects on it. In addition to such equilibrium movements, the observed RER is also influenced in the short to medium run by transitory shocks to the fundamentals and by macroeconomic and exchange rate policies, which are not part of the fundamentals. RER misalignments can occur (as in the standard PPP theory) when those policies are inconsistent with the fundamentals. For example, in a system of pegged nominal exchange rates, expansionary fiscal and monetary policy can be a cause of persistent real overvaluation; Edwards (1989) and Elbadawi (1989) provide strong empirical evidence on this. In this context, we test the controversial issue of whether public saving (or contractionary fiscal policy) is an efficient tool for sustaining real exchange rate targets, as it has been suggested in the Chilean debate.

It is important to stress that given the intertemporal nature of the ERER definition employed in the paper, an empirically consistent modelling of the RER is not trivial. Elbadawi (1993) has shown however that a cointegration-error correction approach is adequate in this framework because it accounts for the following desirable properties: (i) it is consistent with a behavioral model specifying the ERER as a forward-looking function of the fundamentals; (ii)

[1] Edwards (1986) and chapter 2 of Edwards (1989) formalize this concept in the context of an intertemporal optimizing model; see also Lizondo (1989).

it allows for flexible dynamic adjustments of the RER toward the ERER; (iii) it allows for the influence of short to medium run macroeconomic and exchange rate policy on the RER; and (iv) stochastic non-stationarity suggests a time series-based decomposition of the fundamentals into permanent (sustainable) and transitory components. In the following section we state the basic traded-nontraded model which gives the ERER that solves the equilibrium condition in the home goods market under static expectations and assuming a given level of capital flows. Under unit-root non-stationarity and cointegration, this model is equivalent to a model that solves the ERER as a forward-looking function of the fundamentals. The endogenization of domestic absorption as a function of anticipated future RER depreciation permits this forward-looking solution and an appropriate re-interpretation of the standard model as a cointegrated relationship.

Despite the fact that the basic model allows the estimation of the long-run link between capital flows and the RER, the cointegration equilibrium does not offer any guidance on the debate on the direction of causation. We address this issue by testing for the existence of feedback effects from the RER to capital flows in the context of an error-correction model (ECM), the dynamic counterpart of the cointegration equilibrium (Engle and Granger 1987, Phillips and Loretan, 1991).

In section 3 the model is applied to the Chilean case to estimate a long-run cointegration specification for the ERER, as well as the corresponding short-run error-correction model. In section 4 the estimated long-run relationships are used to derive the ERER and the corresponding RER misalignment. Conclusions and some policy implications are collected in section 5.

2. AN EMPIRICAL MODEL OF THE EQUILIBRIUM REAL EXCHANGE RATE

We extend the standard RER models of Rodriguez (1989) and Edwards (1987) to analyze the effects of financial flows on the equilibrium real exchange rate in a cointegration-error correction framework. Consider a small economy with three sectors (importables, exportables and non-tradable goods) for which the international price of traded goods is assumed to be exogenous. The domestic price of tradables, then, is determined by the level of tariffs and the nominal exchange rate (E). Let P_x^* and P_m^* be the dollar-denominated international prices of exportables and importables and t_x and t_m the net export and import tax rates, respectively. The (domestic) price index of tradable goods is defined as:

$$P_T = E[(1 - t_x)P_x^*]^{\alpha}.[(1 + t_m)P_m^*]^{1-\alpha} \tag{1}$$

On the other hand, the price of non-tradables is endogenously determined as the result of the interaction of supply and demand. The latter is disaggregated into private and public components (E_{PN} and E_{GN}, respectively); we assume that the proportion of private expenditure allocated to non-tradable goods depends on the prices of exports, imports and non-traded goods (P_x, P_m, and P_n, respectively), and that government expenditures in non-tradables is a fraction (g_N) of total government expenditure. Hence, the total demand for non-traded goods is expressed as:

$$E_N \equiv E_{PN} + E_{GN} = d_n(P_x, P_m, P_n).[A - g.Y] + g_N.g.Y \tag{2}$$

where d(.) is the proportion of private expenditure (absorption less total government expenditure) in non-traded goods, A is absorption, Y is income, and g is the ratio of government expenditures to income.

The supply of nontraded goods, which is also specified as a fraction of income, depends on the prices of tradable and non-tradable goods:

$$S_N = s_n(P_x, P_m, P_n)\ Y \tag{3}$$

Equation (4) sets the equilibrium condition in the non-traded goods market ($S_N = E_N$), which in turn determines P_n:

$$s_n(P_x, P_m, P_n) = d_n(P_x, P_m, P_n).\left[\frac{A}{Y} - g\right] + g_n.g \tag{4}$$

Defining the real exchange rate, e, as the relative price of non-traded to tradable goods we have:

$$e = \frac{P_n}{EP_x^{\alpha} P_m^{1-\alpha}} = \frac{P_n}{EP_x^{*\alpha} P_m^{*1-\alpha}(1-t_x)^{\alpha}(1+t_m)^{1-\alpha}} \tag{5}$$

Equations (4) and (5) can be solved for the level of the RER that ensures instantaneous equilibrium in the nontraded goods market, for given levels of the exogenous and policy "fundamentals".

$$\underset{}{e = e(}\underset{(+)}{\frac{A}{Y}},\ \underset{(?)}{TOT},\ \underset{(+)}{t_x},\ \underset{(+)}{t_m},\ \underset{(+)}{g_N},\ \underset{(?)}{g}) \tag{6}$$

where TOT represents the terms of trade (P_x^*/P_m^*). Equation (6) implies that higher levels of absorption, trade taxes, and public expenditures on nontradables are consistent with a more appreciated RER. The effects of TOT and total government expenditures cannot be determined a priori; the empirical evidence, however, shows that improved TOT and higher government expenditure tend to lead to RER appreciation.[2] The former arises because the income effect of an improvement in the TOT usually dominates its substitution effect, while the latter is due to the tendency of governments to spend more on non-traded goods than the private sector.[3]

Following Elbadawi (1993) we extend the basic model of equation (6) by endogenizing private absorption as a function of net capital inflows and the expected real exchange rate depreciation:

$$\frac{A}{Y} = (\underset{(+)}{\frac{NKI}{Y}},\ \underset{(-)}{[{}_te_{t+1} - e_t]}) \tag{7}$$

where NKI are net capital inflows and ${}_te_{t+1}$ is the expected real exchange rate. As shown below, this extension yields a forward-looking expression for the ERER as a function of the expected path of its fundamentals.

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[2] See, for example, Edwards (1989).

[3] Other potential determinants of the RER, such as productivity changes, can be included by an appropriate re-specification of s_n (.).

An empirically convenient version of the model described by equations (6) and (7) is:

$$\log e_t - \lambda_t \log e_{t+1} = \alpha_0 + \alpha_1 \log TOT_t - \alpha_2 \log OPEN_t + \alpha_3 \log g_t - \alpha_4 Log(\frac{Public\,Inv_t}{GDP_t})$$

$$+ \alpha_5 \frac{Longcap_t}{GDP_t} + \alpha_6 \frac{Shortcap_t}{GDP_t} + \alpha_7 \frac{Portfolio\,Inv_t}{GDP_t} + \alpha_8 \frac{F.Direct\,Inv_t}{GDP_t} \quad (8)$$

$$= \delta' F_t$$

where F_t represents the a vector of fundamentals (TOT, Openness, etc) and δ is a vector of coefficients. Note that NKI has been decomposed into long-term capital inflows (Longcap), short-term capital inflows (Shortcap), portfolio investment (Portfolio Inv) and foreign direct investment (F. Direct Inv). In addition, public investment as ratio of GDP is included as a proxy of $(1-g_N)$, given the difficulties to obtain reliable data on E_{GN}.

The variable OPEN is defined as the sum of exports and imports as ratio to the GDP. Its use as a proxy for commercial policy (t_x, t_m) is justified because of the difficulty of obtaining good time-series data on t_x and t_m and also because it may account not only for explicit commercial policy but also for implicit, though very important, factors such as quotas and exchange controls. Note that the empirical regularities regarding the signs of TOT and government expenditures are assumed.[4] Since the equation is relevant for the determination of the long run RER, the short-run capital flow and portfolio investment component of capital flows are expected to have non-significant effects.

The model in equation (8) can be solved recursively to yield:

$$log\,\bar{e}_t = \sum_{j=0}^{\infty} \lambda^j \delta'_t \bar{F}_{t+j} \quad (9)$$

Note that the equilibrium exchange rate ($\bar{e}$) is determined by the expected long-run path of the fundamentals. Hence, in order to have an empirical measure of the RER it is necessary to estimate the sustainable level of the fundamentals. Williamson (1993) recommends an ex-ante

[4] Equation (8) appears in several forms in the empirical tradition of the RER literature: e.g. Edwards (1986), Elbadawi (1989 and 1993), Mundlak et al (1987) and Valdés et al (1990).

approach, the so-called "fundamental equilibrium exchange rate" (FEER), which calls for specifying (or assuming) behavioral specifications for the fundamentals and using the real exchange rate equations in the context of a bigger model to derive the trajectory of the equilibrium real exchange rate given the assumed paths of the fundamentals. The approach used in this paper exploits the time-series properties of the variables to get the long-run trajectory of the RER and its fundamentals and, consequently, corresponds to the ex-post version of the FEER concept.

Stochastic non-stationary, cointegration and the ERER

When fundamentals are characterized by unit-root nonstationary processes, the model in equation (9) is consistent with the following long-run cointegrated equilibrium (Kaminsky, 1988)[5]:

$$\log \tilde{e}_t = \frac{1}{1-\lambda}\,\delta'\tilde{F}_t + \eta_t \qquad (10)$$

where $1/(1-\lambda)\delta'$ is the cointegrating vector and η is an uncorrelated random disturbance.

This is an important advantage of cointegration, as it allows the derivation of a simple empirical framework from a much more complicated theoretical model. Nevertheless, to determine the ERER it is necessary to find a practical approximation to the concept of "sustainability" on the part of the fundamentals. Here again stochastic non-stationarity proves to be a useful property. The permanent (or sustainable) components of the fundamentals can be obtained by using a suitable time-series decomposition technique (eg, Beveridge and Nelson (1981) or Campbell and Mankiw (1987)).

[5] The idea of cointegration states that even though individual series may be non-stationary, there may exist a linear combination of them which is stationary. More formally, let the n-vector y_t be composed of n-non stationary variables $(y_{it}, \ldots y_{nt})$, then y_t is said to be cointegrated if there exists at least one n-element vector β such that $\beta' y_t$ is trend stationary. This is a mild definition of cointegration (Campbell and Perron, 1991), which is more suited to the empirical analysis of economic date since it allows the inclusion of deterministic components (such as trends and structural break dummies) in the cointegration model.

This specification is also consistent with a dynamic error-correction model[6], which describes the short-run movements of the RER as arising from the presence of transitory shocks to fundamentals and non-fundamental variables (such as exchange rate and monetary policies), as well as a result of the self-correcting mechanism that adjusts previous period disequilibria:

$$\Delta \log e_{t+1} = b_0 \left(\frac{1}{1-\lambda} \delta' F_t - \log e_t \right) + b_1' \Delta F_{t+1} + b_2' \Delta \log Z_{t+1} + \epsilon_{t+1} \qquad \textbf{(11)}$$

where Z_t is a vector of stationary variables (including the rate of change in domestic credit to GDP, short term capital inflows and the rate of nominal exchange rate devaluation), and the disturbance ε_{t+1} is a stationary random variable composed of the one-step-ahead forecast error in the RER (i.e. $\Delta\log e_{t+1} - {}_t\Delta\log e_{t+1}$). The error-correction term $\left(\frac{1}{1-\lambda} \delta' F_t - \log e_t \right)$ in equation (11) clearly incorporates the forward-looking sources of RER dynamics. Suppose, for example, that we start from an initial condition of real overvaluation (i.e. the error-correction term is negative); then, the self-correcting mechanism immediately calls for a future depreciation in the actual RER. This effect is captured by the negative error-correction term and its positive coefficient in the $\Delta\log e_{t+1}$ specification. The speed at which this automatic adjustment operates depends on parameter b_0, which falls in the interval [0,1]. A value of b_0 equal to one indicates prompt adjustment in just one period; the smaller the value of b_0, the slower the adjustment is.

In addition to the long-run (equilibrium) impact of the fundamentals on the RER, which is captured by the cointegration vector, temporary changes in the fundamentals may also have short-run effects which are captured by the vector b_1. The effects of short-run shocks in exchange rate and macroeconomic policies are given by the coefficients in b_2. For example, as pointed out by Edwards (1989), a nominal devaluation will help the adjustment process only to the extent that the initial situation is one of overvaluation, and only if the nominal exchange rate adjustment is accompanied by supporting macroeconomic policies; i.e, in terms of our equation the error-correction term is negative and other policy variables included in vector Z (eg, the rate of

[6] Engle and Granger (1987).

domestic credit expansion net of real GDP growth) do not offset the effects of the nominal devaluation.

3. AN APPLICATION TO THE CHILEAN CASE

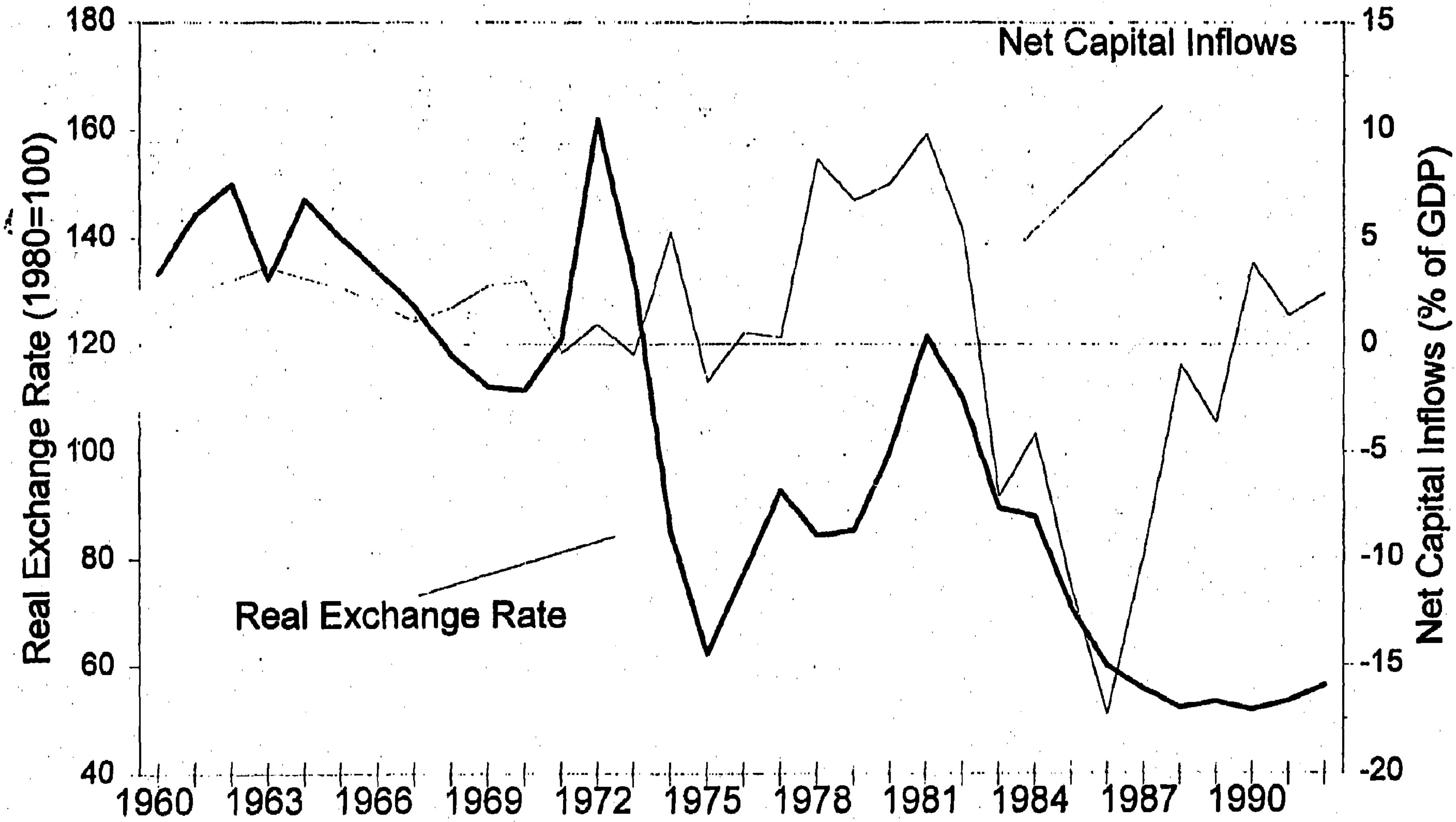
In this section the model presented above is estimated for the period 1960-1992, using annual observations of the corrected real exchange rate (see Figure 1), calculated by CIEPLAN. The series is an alternative measure to the official RER calculated by the Central Bank, that takes into account measurement problems with the official CPI during the 1972-74 period (when most transactions were undertaken at black-market prices) and 1976-78 (when the official price index presents methodological miscalculations).[7]

All variables were tested to verify whether they can be represented more appropriately as difference or trend stationary processes. Table A.2 in the Appendix collects the results of applying unit-root tests to the data. It is apparent that with the only exception of the short-term capital inflows all fundamentals present evidence of non-stationarity. Rejection of the unit-root hypothesis for the first difference of the variables ensures that we are dealing with integrated processes of first order, I(1). It has been frequently argued that standard unit-root tests are sensitive to the presence of structural breaks; a stationary variable affected by breaks can easily "mimic" non-stationary patterns and the ADF test has been proved quite sensitive to this problem (Perron, 1989). In the Chilean case this may be an important issue because of the economic reform package applied from 1975 onwards. To overcome this limitation we use a procedure suggested by Perron (1989), which modifies the conventional ADF test by introducing a set of dummy variables which control for the presence of breaks. The results, presented in the last two columns of Table A.2, confirm that none of the fundamentals are stationary processes.

[7] See Cortázar and Marshall (1980).

Figure 1

REAL EXCHANGE RATE AND NET CAPITAL INFLOWS IN CHILE: 1960-1992



3.1 The Long-Run Cointegrated Equilibrium.

Once confirmed that the variables behave as integrated processes, tests for cointegration can be undertaken. We use the two-step procedure for estimating cointegration-error correction models suggested by Engle and Granger (1987). In the first step the cointegrating regression is estimated by ordinary least squares; its errors are used in the second step to estimate the error-correction mechanism and the short-term dynamic model. Despite evidence that this procedure may be non-optimal because of the presence of nuisance parameters (Campbell and Perron, 1991), we rely on it because of two facts: (a) as discussed below, in this particular case the estimation is likely to be free of nuisance parameters and, (b) the sample, though spanning a long-run horizon, is of low frequency (annual data) so that an alternative non-linear estimation may yield inconsistent results (Phillips, 1983).

Two conditions ensure that the OLS estimation of the cointegration regression is asymptotically optimal: errors should be non-correlated and right-hand side variables should not be Granger-caused by left-hand side variables (Phillips and Loretan, 1991). The results in Table 1 show that none of the cointegrating equations present evidence of serial correlation of any order, and also that errors are stationary. The results in Table A.3 in the appendix also show that, excepting government expenditure, the RER does not Granger-cause any of the fundamentals.[8] With regards to the causality between the RER and capital flows, the tests suggest that the long-run causality among these variables would be as that suggested by Edwards (1988). We acknowledge, however, that causality can change as a result of policy shocks and other breaks; the small number of observations available, however, preclude us from making a formal testing.[9]

The above considerations allow us to estimate directly the cointegration regression. The results, presented in Table 1, strongly corroborate the theoretical model outlined in section 2, thus permitting the interpretation of equation (7) as the long-run equilibrium relationship. As a first

[8] Note that, though causality can appear as a spurious result, absence of causality is never a spurious result (Granger and Newbold, 1974); finding absence of feed-back effects supports the notion that the first step is free of nuisance parameters.

[9] Estimating Granger test in partitions of the sample (eg. 1960-1974 and 1975-1992) did not alter the basic results of the tests, but the reduced number of observations in each sub-sample limits the confidence on the inference.

TABLE 1
Estimation Results of the Cointegration Equations
1960-1992

	Extended Model	Final Model
Constant	4.92 (18.1)	4.81 (18.4)
Log of Terms of Trade	-0.12 (-2.53)	-0.11 (-2.42)
Openness	-1.09 (-12.4)	-1.11 (-15.8)
Log Government Expenditures (% of GDP)	0.31 (2.79)	0.31 (2.74)
Log Public Investment (% of GDP)	-0.15 (-2.38)	-0.13 (-2.37)
Long Term Capital Inflows (% of GDP)*	0.89 (2.50)	0.97 (2.79)
Foreign Direct Investment (% of GDP)	-1.67 (-1.11)	-
Portfolio Investment (% of GDP)	-1.03 (-0.75)	-
Dummy 1971-1973 = 1	-0.26 (-3.67)	-0.23 (-3.63)
R^2	0.96	0.96
Durbin-Watson stat.	1.52	1.46
Box-Pierce Q test	12.1	12.9
ADF test on residuals	-4.19	-4.03

Note: (*) Long-term capital inflows includes foreign direct investment in the final model.
Critical values for the ADF test on the residuals are -4.15 and -4.90 at 5 and 1%, respectively.

approach to modelling the data we separate capital inflows among portfolio investment, foreign direct investment and long-term capital inflows. Results are conclusive that the first two components convey no information whatsoever for the estimation of the RER, because when tested separated or jointly yields statistically non-significant parameters. Table A.4 in the appendix shows that these results are not due to colinearity among these variables, since their contemporaneous correlation do not reach 0.35 for any pair of them. Moreover, since there is a presumption that the breakdown between the two latter may be to some extent inaccurate (because of financial funds fungibility) we deemed reasonable to use an aggregated measure in the final model.

One of the most interesting findings in Table 1 is that of the importance of the volume of trade (degree of openness) in determining the level of the RER. The negative and significant sign supports the notion that reforms aimed at reducing tariffs and eliminating trade restrictions are consistent with a more depreciated RER. In the case of the Chilean reforms, tariffs were reduced from a high 80% average during the 1960-1974 period to a low level of 20% in the 1975-92 period; subsequently the volume of trade increased from 25% to 55% of the GDP. With an elasticity of the RER to openness which clusters around 1, three-quarters of the 45% depreciation of the RER can be linked to the increase in trade volume. This result is consistent with previous research and in particular with ongoing parallel research by Quiroz and Chumacero (1993), which by means of a simulated real-business cycle model conclude that the decline on tariffs, at a minimum, depreciated the RER in the order of 40%.

The results for the ratio of government expenditures to GDP show a positive elasticity, implying that fiscal spending tends to concentrate more on non-traded goods compared to the private sector and that, consequently, unsustainable government deficits lead to exchange rate overvaluation. The small magnitude of the effects points to the fact that substantial public saving is required to sustain a high RER in the presence of capital inflows. The last years witnessed a bitter discussion among Chilean economists on this issue (see Arrau et al, 1992) as increasing capital inflows called for an appreciation of the Chilean peso at the cost of reducing export competitiveness. Our result adds to mounting evidence that, in order to provide a sustainable high RER in an efficient way, measures outside the fiscal area should be used. Moreover, the composition of government expenditures also matters.[10] The significant coefficient of the ratio of public investment to GDP suggests, as expected, that government capital expenditures concentrate in traded goods.

The sign of capital inflows is, as expected, positive and significant implying that an increase in foreign exchange appreciates the real exchange rate. The magnitude of the estimated elasticities --in the range of 1-- suggests that the effects are quite strong and, again, raises doubts on the ability of the authority to sustain a real exchange rate above the long-term equilibrium by altering its policy mix. The data in Table A.1 show that long-term capital inflows increased from -10% of GDP in the 1983-87 period to 4% in the 1989-92 period. Other things constant, this change in the capital account of the balance of payments accounts for an appreciation of the RER of about 15%.

The effects of shocks to the terms of trade, as remarked in Section 2, are theoretically ambiguous. The negative sign obtained suggests, contrary to conventional results, the dominance of substitution over income effects. Two non-exclusive explanations can be suggested for this phenomenon: (a) it is likely that in this regressions TOT captures only substitution effects in the demand for traded goods, because income effects are channeled through the expansion of trade volumes -directly captured in the degree of openness- and/or in the increase of sustainable long-run capital inflows; (b) a more circumvoluted explanation suggests that if wages are indexed backwards -as it was the practice for most of the 1960-1992 period- and foreign demand expands, the increase in exports and aggregate demand would induce a rise in prices (or inflation) which, in turn, implies a reduction in current real wages. The cut in real salaries allows the supply of non-tradables to increase, thus reducing the RER. Schmidt-Hebbel and Serven (1994) found a similar behavior when simulating an intertemporal rational expectations model for the Chilean economy. Note that the negative sign has also been found in other two studies. Valdés et al (1990) found a negative effect for TOT in a model which controlled indirectly for income effects. Repetto (1992) also found a negative coefficient when estimating a RER equation which included, among other variables, capital inflows in the specification. The size of the coefficient in the latter was, however, twice as large as in our case (see Appendix Table A.5).

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[10] However, in the Chilean case Elbadawi (1993) found these effects to be negligible.

Finally, a dummy variable was introduced to capture the severe disarray in the economy during the 1971-1973 period, in which an excessive expansion of domestic credit was accompanied by drastic price and currency controls and an increasingly distorted foreign trade structure.

This estimated cointegration equation is used below to estimate the short-term dynamic models. However, prior to discussing the results on the ECMs it is important to note that the cointegration estimation of the corrected RER is remarkably stable along the 30-year period. Standard stability tests (Cusum and Cusum of squares) as well as the recursive estimation of residuals and parameters show little evidence of instability (see Figures A1 to A7 in the appendix). The former suggest no evidence of structural breaks, not even in 1975, which points to the fact that the cointegrating vector accounts for the break in the series unveiled by unit-root tests.

3.2 The Error-Correction Model.

To perform the estimation of the short-run model of the RER we follow the methodology suggested by Phillips and Loretan (1991). Its main difference with standard ECM specification is that it includes *leads* of the right-hand side variables to capture the presence of potential feed-back effects from the RER to the fundamentals. Drawing from our previous results on causality we test those variables in which there was some evidence of two-way causality, i.e., nominal exchange rate movements and government expenditure. Capital inflows are also included as a double check on our previous results on causality tests.

The results reveal a wealth of dynamic effects that were missing in static studies and that help sharpening our theoretical predictions. First, note that leads of the fundamentals are not significant, consistent with prior evidence on causality which suggested the absence of feed-back effects.[11] In addition, short-term capital inflows -which proved to have no effect in the long-run- are quite important in the short-run. Second, note that the size of the coefficient of openness in

[11] Non-significant lags and leads were sequentially deleted, but the results are not affected by the ordering of deletion because colinearity among variables is small.

the short-run model does not differ markedly from that of the long-run model, implying that the markets internalize the effects of increased openness rather quickly (within one year). On the contrary, only half of the change in government expenditure has direct effects on the RER, creating a dynamic pattern of adjustment toward the equilibrium RER. Note that while static models can capture the former relationship, they miss the implicit dynamics of shocks which, even when having small direct effects, tend to build an important long-run effect.

The most interesting result concerns the effects of nominal devaluations on the RER. As anticipated by causality tests, feedback effects between the two variables were likely to exist. The estimated parameter for anticipated devaluations is positive, consistent with rational expectations models of the current account balance (see Obstfeld, 1985). On the other hand, the contemporaneous effect is negative, which is consistent with previous empirical literature (Edwards, 1985). The aggregated effect, nevertheless, recovers the superneutrality of monetary models, i.e., that monetary shocks do not have effects on the rate of change of real variables (like the RER) because the latter effect offset the previous negative effect.[12]

A crucial parameter in the estimation of ECM is, naturally, that associated with the error-correction term. As mentioned, it measures the degree of adjustment of the actual RER with regards to its equilibrium level. While the estimates of the speed of adjustment in Table 2 are smaller than the 0.78 estimated by Elbadawi (1993) for Chile using a similar framework, our estimates are much larger than the 0.19 obtained by Edwards (1989) for a group of developing countries using a partial adjustment model. Note that Edwards estimates suggest that very little adjustment actually takes place and, furthermore, that the adjustment may take an extremely long period to complete. The comparison also shows how different results can be when a dynamic specification is proposed and tested, instead of assuming (ex-ante) a partial adjustment model.[13]

The error-correction coefficients can be manipulated, in the context of the error-correction specification,. to derive the corresponding adjustment speed in terms of the number of years

[12] A joint Wald test cannot reject the null hypothesis that the sum of both coefficients is zero at 95% confidence.

[13] An adjustment parameter of 0.19 implies that a shock dissipates in about 30 years.

TABLE 2
Estimation Results of the Error-Correction Models
1960-1992

	General Model	Final Model
Error Correction Term (speed of adjustment)	0.50 (2.72)	0.56 (3.43)
Δ Openness	-0.88 (-6.77)	-0.99 (-9.15)
Δ Log Gov. Expenditures (% of GDP)	0.21 (2.49)	0.17 (2.80)
Δ Lead Log Gov. Expenditures (% of GDP)	0.17 (1.77)	-
Δ Long Term Capital Inflows (% of GDP)	0.60 (2.31)	0.51 (1.82)
Lead Δ Long Term Capital Inflows (% of GDP)	0.22 (0.77)	-
ΔShort Term Capital Inflows (% of GDP)	0.54 (2.60)	0.63 (3.69)
Nominal Devaluation	-0.10 (-1.14)	-0.14 (-1.90)
Lead Nominal Devaluation	0.09 (1.27)	0.13 (2.02)
Δ Log Public Investment (% of GDP)	-0.11 (-1.48)	-0.12 (-2.00)
Δ Dummy 1971-73	0.20 (4.81)	0.22 (6.44)
Dummy 1979	0.10 (2.58)	-0.21 (-2.84)
Adjusted R^2	0.85	0.85
Durbin-Watson stat.	2.00	2.23
Q(7)	11.3	6.3

Note: Dummy 1979 takes value 1 in that year and 0 otherwise.

required to eliminate a given exogenous shock. According to our calculations it would takes around 1 year to eliminate 50% of the shock and 5 years to clear 99.9% of it.[14]

4. RER AND ERER INDICES FOR CHILE.

The estimated cointegration equation can be used also to compute the equilibrium real exchange rate, ERER, which is determined by the "sustainable" or "permanent" values of the fundamentals. The computation is not straightforward, however, because fundamentals are integrated processes, i.e., their fluctuations correspond to a combination of permanent and transitory shocks, of which only the former are of interest when computing the ERER. To disentangle permanent and transitory shocks we use the Beveridge and Nelson (1981) decomposition method, which generates a measure of the permanent component as the gain function of the innovations of an ARIMA model (Table A.5 in the appendix presents details of the time-series estimation). Of the fundamentals of the RER, the TOT and public investment can be characterized as a random-walk process, for which all innovations are permanent. In the rest of the cases, the gain function is less than 1, implying that only a fraction of each shock remains in the long-run.

It should be noted that this decomposition, which yield a unique dynamic path for each fundamental, does not provide a unique solution for the ERER in terms of the intercept.[15] In order to emphasize the importance of the external balance for this analysis, we normalize the ERER index according to a resource-balance criterion. Hence, we scale the ERER index so that its average is equal to the average of the actual RER over the years in which the resource balance is 'close' to its equilibrium level.[16] Table 4 and Figures 2 and 3 present the estimated equilibrium

[14] Adjustment periods were calculated as: $(1+\alpha)^t = (1+\beta_0)$, where t is the number of periods, β_0 is the error-correction coefficient and $\alpha = 0.5$ and 0.99.

[15] This is because the rational expectations solution for the ERER is not unique. If we assume the unknown ERER function to be given by $g^*(x)$ and the corresponding rational expectations solution to be given by a general Taylor approximation $g(x/\theta)$ (which is assumed to approximate $g^*(x)$ fairly closely); then, using the regression on the observed RER: $y = g(x/\theta) + \varepsilon$ to estimate $g(x/\theta)$ by $\hat{g}(x/\theta) = g(x/\theta)$ does not guarantee that $\hat{g}(x/\theta)$ and $g(x/\theta)$ are equal for each point x in the space of the fundamentals (see Elbadawi (1983) on the validity of the Taylor series interpretation of the regression estimators).

[16] The resource balance is dubbed 'close' to the equilibrium if it is positive.

RER computed with the corrected RER cointegration equation and the estimated permanent component of the fundamentals; the corresponding RER misalignment is calculated as:

$$RER\ Misalignment = \frac{RER - ERER}{ERER}$$

Our estimates agree with those of Edwards (1987) and Elbadawi (1993) in that the ERER show some variability. It follows that at least part of the observed RER variability is related to equilibrium behavior, and that analyses of real exchange rate misalignment based on historical comparisons of observed RER levels (i.e. the PPP approach) may lead to erroneous conclusions.

The figures show a remarkable success on the part of the computed index in reproducing well known overvaluation (and undervaluation) episodes of the recent macroeconomic history of Chile. In particular, note that misalignment is first low but stable in the 1964-1970 period. During the administration of Dr. Allende, which expanded markedly both fiscal expenditures and domestic credit (see Table A.1), misalignment increased to a high level of 28% and remained quite high even after the coup d'etat of 1973. The reform process started in 1975 not only brought the RER to its equilibrium level, but amounted also to a real depreciation of 25% for the period 1975-1978, compared to the previous 15 years. The fixing of the nominal exchange rate in 1979 and the massive flow of foreign borrowing induced a wave of wide misalignment in the RER (which peaked at 21% in 1980-81 period). Despite important nominal devaluations in 1982, the year of the debt crisis, macroeconomic mismanagement did not bring much relief to the burden of the RER in the following years, until the Büchi administration came up with a high-real-exchange-rate macroeconomic proposal in 1986. The high real exchange rate policy reversed the chronic tendency towards appreciated RER, but as foreign capital returned to flow to Chile it became increasingly costly for the Central Bank to sustain it. Despite measures to allow outflows of capital, the large volume of capital inflows continued to suggest a more appreciated equilibrium RER. In this context, the nominal revaluation of 5% in 1992, though a signal in the correct direction, seems to be insufficient to align the RER during 1992.

Figure 2

REAL EXCHANGE RATE
ACTUAL AND EQUILIBRIUM VALUES

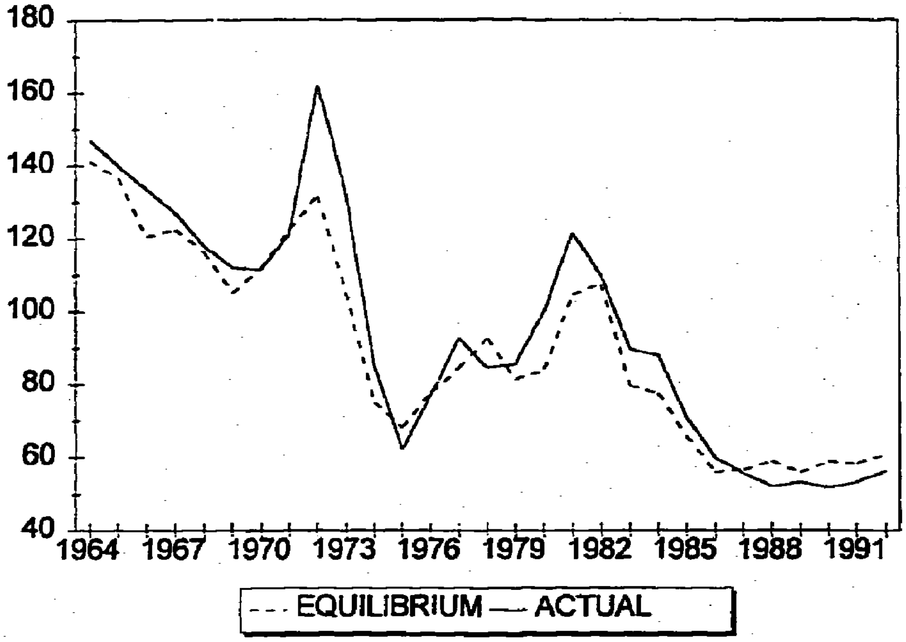

Figure 3

REAL EXCHANGE RATE
MISALIGNMENT

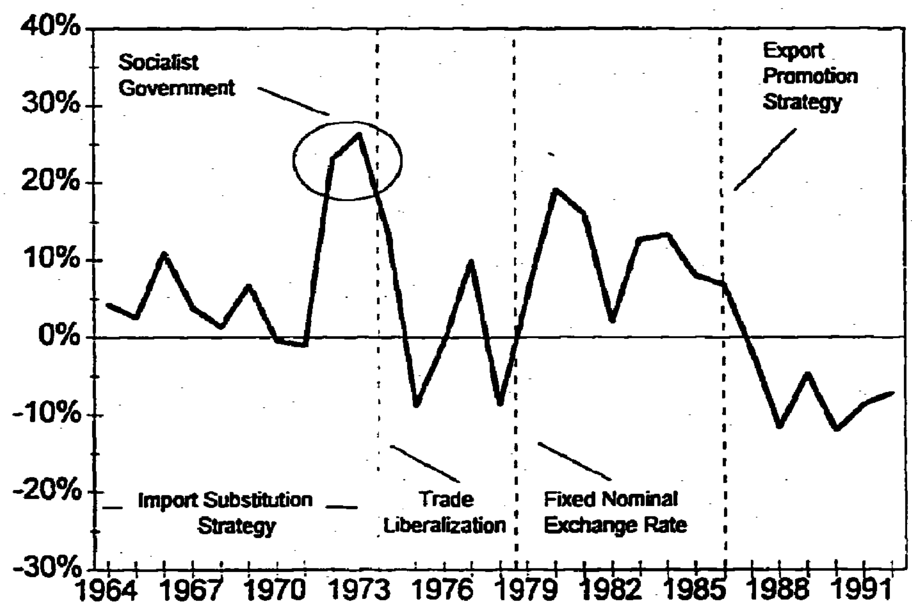

TABLE 3
Equilibrium Real Exchange Rate and Misalignment
1965-1992

	Corrected Real Exchange Rate		Misalignment
	Actual	Equilibrium	(percent)
1965	140.0	129.3	8.3
1966	133.6	115.3	15.9
1967	127.1	118.2	7.5
1968	118.0	111.2	6.2
1969	112.0	98.9	13.3
1970	111.4	108.8	2.4
1971	121.2	122.2	-0.8
1972	162.0	131.8	22.9
1973	132.8	103.9	27.9
1974	85.3	70.1	21.7
1975	62.1	61.2	1.6
1976	77.1	74.5	4.0
1977	92.7	83.5	11.1
1978	84.5	89.8	-5.9
1979	85.4	80.5	6.1
1980	100.0	82.5	21.2
1981	121.5	102.8	18.2
1982	109.9	103.7	6.0
1983	89.5	83.7	6.9
1984	87.9	79.0	11.3
1985	70.9	66.0	7.3
1986	59.9	57.6	3.9
1987	55.6	54.9	1.2
1988	52.0	54.6	-4.7
1989	53.2	54.3	-2.1
1990	51.7	59.0	-12.4
1991	53.3	60.3	-11.6
1992	56.3	61.7	-8.7

Note: The misalignment is calculated as (RER-ERER)/ERER.

5. CONCLUSIONS

The real exchange rate has been at the heart of the openness-oriented reforms in Latin America. It has been argued that highly competitive real exchange rates have driven trade reforms and made Latin American products attractive in world markets (World Bank, 1993). It is not surprising, therefore, that the recent massive capital inflows into Latin America and the subsequent real appreciation of their currencies have generated considerable consternation for policy makers and political leaders, as well as concern among economists and experts.[17]

In Chile, the debate on the role of capital flows started in the early 1980s, at the onset of the debt crisis. Issues related to the role of capital flows in disrupting macroeconomic management -including the direction of causation between real exchange rates and capital flows-, the extent to which capital flows are sustainable and hence whether or not their influence on the real exchange rate is consistent with equilibrium behavior, have been the subject of much controversy.

This paper contributes to the debate by estimating the cointegrating long-run equilibrium path between the RER and capital flows, among other fundamentals. The cointegration model allows a re-interpretation of static estimates of the equilibrium real exchange rate (ERER) model to be consistent with long-run forward-looking behavior and flexible short-run dynamics (Elbadawi, 1993). Furthermore, stochastic non-stationarity provides an empirical measure to the concept of "sustainability" of fundamentals. The estimation of the long-run cointegration equilibrium equation of the ERER and the corresponding dynamic error-correction specification, strongly corroborates the theoretical model and improves the results of previous studies.

Among the components of the capital account, our results suggest that only long-term capital flows and direct foreign investment are cointegrated with long-term ERER, with an elasticity clustering around 1. Short-run capital flows, on the other hand, were found to have influence on the RER in the short-run only. This findings agree with the notion that if capital flows are regarded to be genuinely long-term, their effect on the real exchange rate is a true equilibrium phenomenon, and in this case no policy action will be required. The rather

[17] See Calvo, Leiderman and Reinhart (1993) for an exposition of the debate.

appreciable effect estimated for capital inflows is in sharp contrast with the positive but small estimated effect for the ratio of government expenditure to GDP. The latter implies that fiscal spending tends to concentrate on non-traded goods compared to the private sector and that, consequently, unsustainable government deficits lead to exchange rate overvaluation. However, the comparison of the two effects suggests that, sterilizing the appreciating effects of capital inflows would require significant and sustained fiscal retrenchment.

In terms of the long-run effects of other fundamentals, the estimated elasticity of the volume of trade (degree of openness) is the most interesting. The result supports the notion that trade liberalization requires a more depreciated ERER. It also corroborates the view that without a significant real depreciation, Chile's trade liberalization could have been difficult to sustain. With an estimated elasticity of the RER to openness around 1, we calculate that three quarters of the 45% depreciation of the RER can be linked to the increase in trade volume. This finding is consistent with parallel research by Quiroz and Chumacero (1993) which, using an entirely different methodology, estimate that the decline in tariffs accounts for a depreciation of the ERER of 40%.

The results of the dynamic error-correction model reveal a wealth of information that was missing in previous studies and that help sharpen our theoretical predictions. Consistent with the empirical literature, we obtained a negative contemporaneous effect of nominal exchange rate devaluations on the RER (Edwards, 1989). On the other hand, the estimated positive parameter for anticipated devaluations corroborates the predictions of the rational expectations models of the current account balance (Obstfeld, 1983). In addition, the aggregated null effect recovers the superneutrality of monetary models.

In addition to providing estimates of the order of magnitudes of influence of capital flows and other fundamentals, our approach also allows computing indices for the ERER and RER misalignment. Using proxies for the "sustainable" path of the fundamentals -suggested by their underlying data generating processes- and subject to a sensible normalization rule, the estimated long-run equation was used to derive indices of the ERER. The estimated RER index and the corresponding rate of RER misalignment are successful in reproducing the salient episodes and characteristics of the recent macroeconomic history of Chile.

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TABLE A.1
SELECTED MACROECONOMIC INDICATORS: 1960-1992

	Real Exchange Rate Official (1980=100)	Real Exchange Rate Corrected (1980=100)	Government Expenditures (% of GDP)	Domestic Credit (% of GDP)	Gross Fixed Investment (% of GDP)	Openess (% of GDP)	Nominal Exchange Ra ($/US$)	Long-term Capital flows (% of GDP)	Foreign Direct Investment (% of GDP)	Portfolio Investment (% of GDP)	Short-term Capital flows (% of GDP)
1960	306.0	133.3	22.9	23.4	20.7	30.6	0.00110	0.6	0.7	-0.2	-0.6
1961	267.6	144.4	23.1	19.9	20.0	28.4	0.00114	2.5	1.2	-0.2	-0.9
1962	289.5	150.0	24.7	26.7	21.4	25.4	0.00152	3.0	0.8	-0.1	0.5
1963	302.9	132.1	23.1	15.0	23.1	28.2	0.00213	3.6	-0.6	-0.1	-2.6
1964	302.9	147.1	22.1	20.9	21.4	26.6	0.00276	3.1	-0.2	-0.1	-2.2
1965	294.3	140.0	25.4	21.7	19.9	27.3	0.00374	2.7	-0.6	-0.1	-0.5
1966	275.4	133.6	25.2	20.3	18.5	29.9	0.00437	1.9	-0.5	-0.1	0.4
1967	261.7	127.1	23.2	21.5	18.3	28.6	0.00579	1.1	0.0	-0.2	0.4
1968	244.0	118.0	20.2	19.5	19.3	29.2	0.00767	1.7	2.2	-0.1	0.8
1969	234.1	112.0	21.3	16.7	19.6	32.8	0.00998	2.8	1.2	-0.1	0.3
1970	223.2	111.4	22.9	17.2	20.4	31.3	0.01223	3.0	-1.0	-0.1	-0.3
1971	242.7	121.2	27.6	31.1	18.3	22.7	0.01580	-0.4	-0.7	-0.1	0.6
1972	254.2	162.0	29.7	42.9	14.8	22.0	0.02500	0.9	-0.0	-0.0	0.3
1973	398.2	132.8	42.3	63.6	14.7	29.6	0.36000	-0.5	-0.0	-0.1	0.7
1974	136.1	85.3	25.0	43.6	17.4	40.2	1.8720	5.3	-5.0	-0.1	-0.5
1975	103.7	62.1	21.0	58.0	15.4	52.9	8.5000	-1.7	0.7	-0.1	1.1
1976	99.0	77.1	18.7	43.6	12.7	45.9	17.420	0.5	-0.0	-0.1	1.5
1977	106.4	92.7	19.8	43.5	13.3	43.0	27.960	0.3	0.1	-0.1	3.8
1978	88.1	84.5	19.4	41.0	14.5	44.5	33.950	8.7	1.1	0.0	2.8
1979	87.4	85.4	19.6	41.0	15.6	49.4	39.000	6.8	1.1	0.2	2.3
1980	100.0	100.0	20.2	44.6	17.8	49.8	39.000	7.5	0.8	-0.2	3.3
1981	118.1	121.5	23.0	51.0	19.5	43.2	39.000	9.9	1.2	-0.1	3.4
1982	109.5	109.9	26.1	87.9	15.0	40.6	73.430	5.3	1.6	-0.1	-2.7
1983	87.7	89.5	25.7	87.4	12.9	45.4	87.530	-7.1	0.7	-0.0	-10.0
1984	87.0	87.9	26.5	108.6	13.2	49.6	128.24	-4.2	0.4	-0.1	3.0
1985	70.4	70.9	30.4	118.9	14.8	55.4	183.86	-11.3	0.7	0.2	2.5
1986	63.3	59.9	27.9	114.4	15.0	57.4	204.73	-17.3	0.7	1.2	4.5
1987	60.2	55.6	26.1	107.1	16.5	62.9	238.14	-9.7	1.2	3.7	-0.7
1988	54.7	52.0	26.3	92.5	17.0	67.5	247.20	-1.0	0.6	3.9	-0.3
1989	52.8	53.2	21.6	82.2	17.9	72.1	297.37	-3.7	0.7	5.5	2.4
1990	51.4	51.7	22.8	79.1	18.8	70.2	337.09	3.8	0.9	2.8	4.3
1991	53.0	53.3	21.5	70.0	17.5	66.8	374.51	1.4	1.8	0.2	-0.5
1992	56.1	56.3	20.5	66.8	18.6	64.7	380.22	2.4	0.9	0.9	2.8

Sources: Col. (1), (3) to (6) Central Bank of Chile.
Col. (7) to (12) IMF (IFS)
Col. (2) CIEPLAN and IMF (IFS)

Table A.2
Order of Integration Tests*
1960-1992

Variable	A.D.F. Test Level	A.D.F. Test First Difference	Perron Test Level	Perron Test First Difference
Real Exchange Rate**	-3.22 (4)	-5.36 (1)	-2.02 (2)	-5.76 (0)
Terms of Trade	-3.16 (4)	-5.20 (0)	-	-
Openness**	-0.69 (1)	-5.20 (2)	-0.93 (2)	-5.71 (2)
Government Expenditures (% of GDP)	-3.19 (2)	-5.60 (0)	-	-
Long-Term Capital Inflows (% of GDP)	-2.41 (0)	-6.27 (1)	-	-
Portfolio Investment (% of GDP)	-3.16 (1)	-4.30 (0)	-	-
Foreign Direct Investment (% of GDP)	-2.64 (4)	-6.44 (1)	-	-
Short-Term Capital Inflows (% of GDP)	-4.38 (0)	-	-	-
Public Investment (% of GDP)	-0.79 (1)	-5.04 (1)	-	-
Nominal Devaluations (%)	-2.62 (1)	-6.54 (0)	-5.66 (0)	-
Critical Values - at 5%	-3.56	-2.97	-3.60	-3.60
- at 10%	-3.23	-2.63	-3.35	-3.35

Notes: (*) Numbers of lags in parenthesis; (**) Tests for the presence of a structural break in 1974-75.

Table A.3
Granger Causality Tests
1960-1992

	Null Hypothesis: RER does not Granger-cause:	Null Hypothesis: RER is not Granger-caused by:
Openness	0.43	2.48*
Government Expenditure (% GDP)	3.01*	17.8**
Terms of Trade	1.15	2.63*
Long-Term Capital Inflows (% of GDP)	0.86	2.66*
Public Investment (% of GDP)	0.05	3.29**
Short-Term Capital Inflows (% of GDP)	1.75	0.67
Portfolio Investment (% of GDP)	1.40	0.45

Note: (*) Significant at 10%, (**) significant at 5%.

Table A.4
Correlation Matrix of Capital Inflow Components
1960-1992

	Short-Term Capital Inflows	Portfolio Investment	Foreign Direct Investment	Long-Term Capital Inflows
Short-term Capital Inflows	-	0.05	0.12	0.16
Portfolio Investment	-	-	-0.10	-0.33
Foreign Direct Investment	-	-	-	0.16
Long-Term Capital Inflows	-	-	-	-

TABLE A.5
Previous Estimates of RER equations.
Effects on the long-run RER of an increase of 1% in:

	Government Expenditures	Terms of Trade	Capital Inflows	Period
Corbo (1985, quarterly data)	0.21	-	-	1977-1983
Valdés, Muchnik and Hurtado (1990)	0.23	-0.29*	-	1960-1982
Marshall and Schmidt-Hebbel (1991)	1.09**	0.14	-	1960-1988
Arrau et al (1992 quarterly data)	0.8 - 1.1	-	-	1977-1991
Repetto (1992)	0.30**	-0.30	0.016	1960-1990
Elbadawi (1993)	0.85	0.29	-	1965-1990
Quiroz and Chumacero (1993)	0.41	0.25	-	1960-1988
Edwards (1989, quarterly data)	-	-	0.15	1977-1981
Edwards (1989) (panel for 12 Latinamerican countries)	0.30	0.04**	-	1962-1984

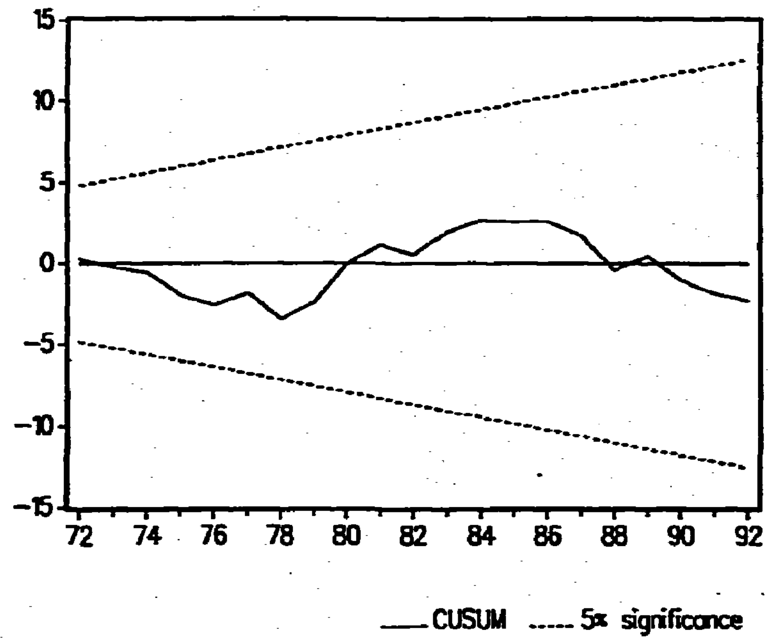
Note: (*) An offsetting parameter of 0.27 was also found in this estimate.
(**) Parameter non-significant at 5%.

TABLE A.6
Estimated ARIMA models for fundamentals
1960-1992

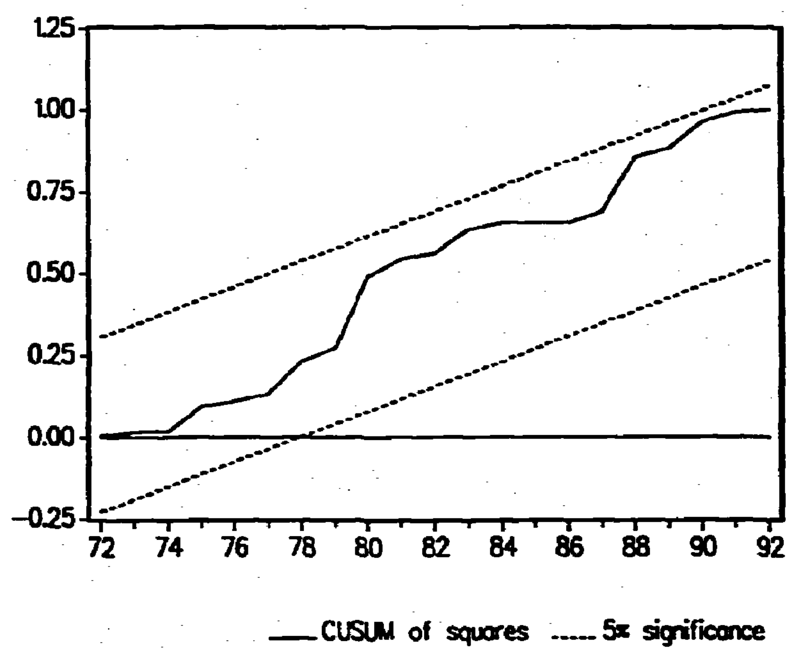
	R^2	Q(7)
$(1 - 0.45L + 0.48L^2)\ \Delta$ Log [$Open_t$] = 0.02 + ε_t (-2.70) (2.45)	0.35	8.55
1 - 0.45L + 0.48L^2) Δ Log [Gov. $Exp._t$] = $(1+1.78L-0.81L^2) + \varepsilon_t$ (3.40) (5.01) (3.20) (-1.62)	0.37	7.42
$(1 - 0.14L^2 + 0.78L^5)\ \Delta$ Log [$Longcap_t$] = (1 - 0.35L) ε_t (-0.78) (4.07) (1.75)	0.40	4.58

Figures A.1 and A.2

Stability Tests: Cusum

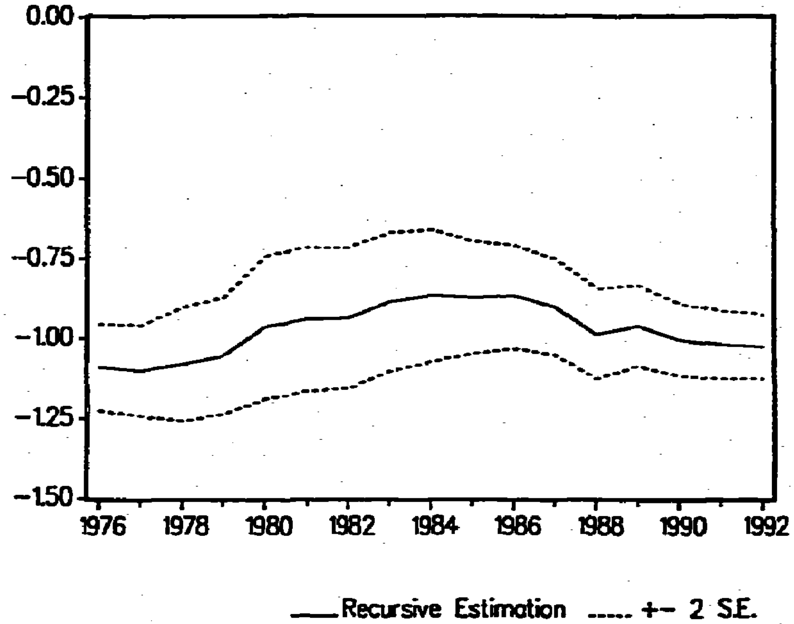


Stability Tests: Cusum of Squares

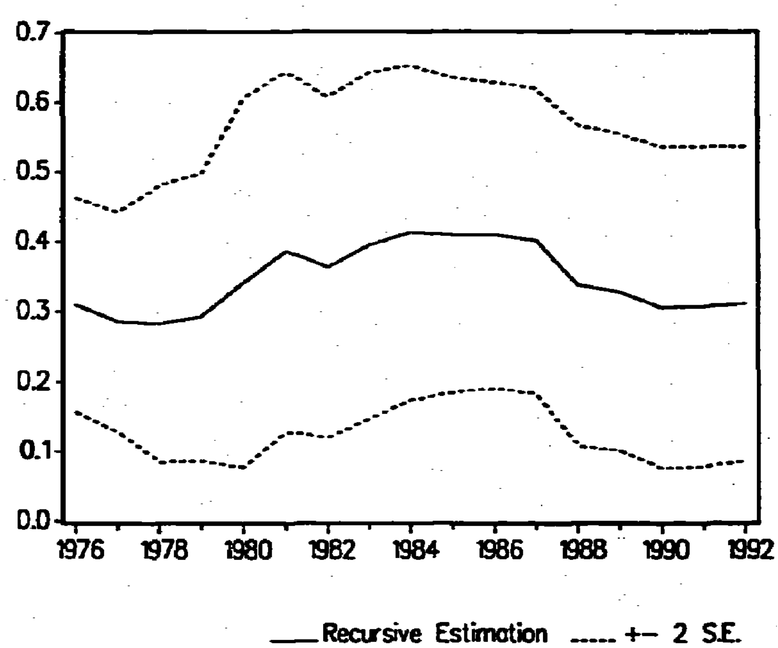


Figures A.3 and A.4

Recursive Estimation of the Coefficient of Openess

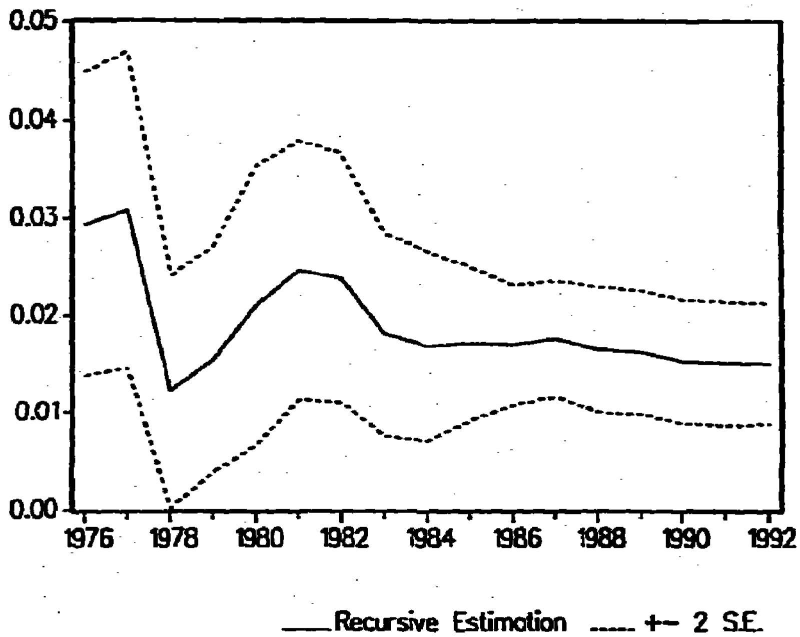


Recursive Estimation of the Coefficient of Government Expenditures



Figures A.5 and A.6

Recursive Estimation of the Coefficient of Capital Inflow



Recursive Estimation of the Coefficient of Investment

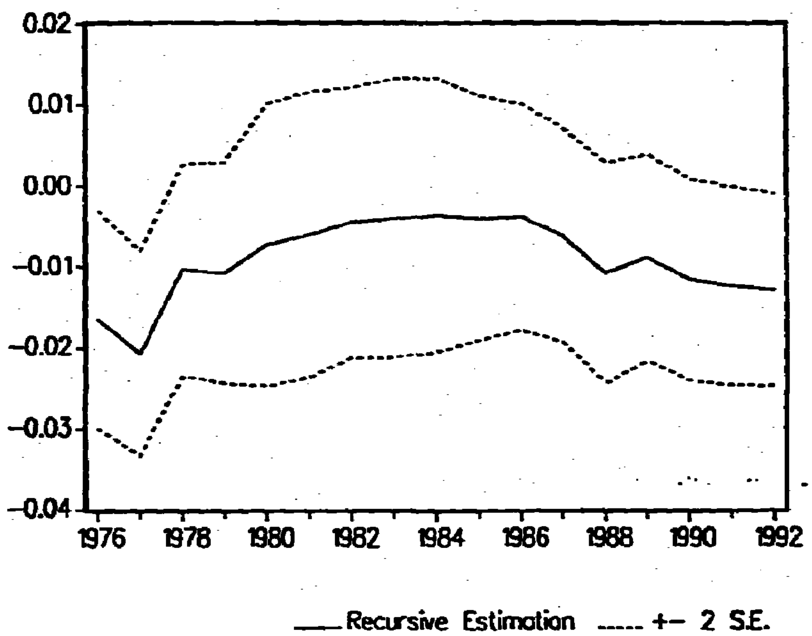
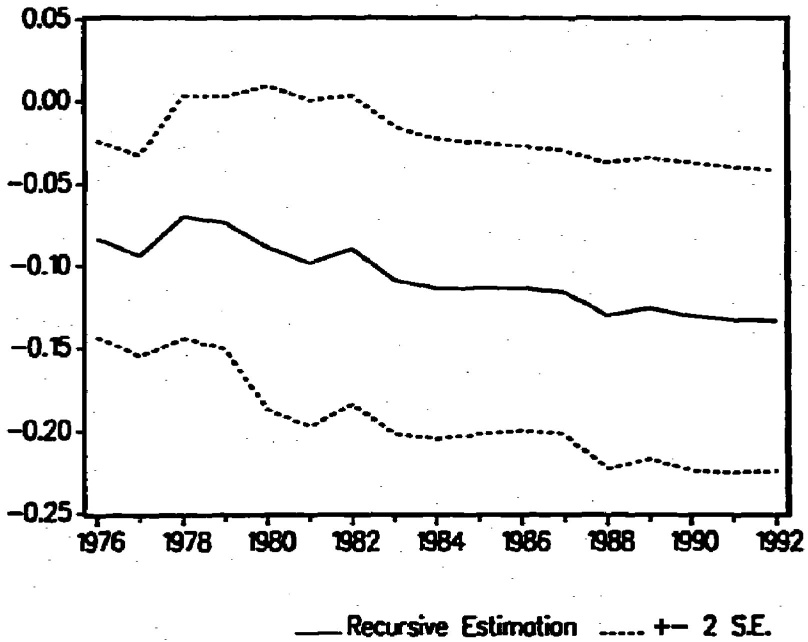


Figure A.7
Recursive Estimation of the Coefficient of Terms of Trade



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